AMERICAN RIVER PROJECT
LOCAL SPONSOR PERSPECTIVE

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I. BACKGROUND

Flood Control History

The City of Sacramento sits at the confluence of the Sacramento and American Rivers. Together, these rivers drain an estimated 1860 square miles including over half the State of California and a portion of Oregon. As with most western cities in the 1800's, Sacramento was located near the river for transportation purposes. Before there were highways, airports and even trains, the river was the source of life. It provided water to drink, irrigate crops, raise animals and a means of contact with the outside world. Yet as much as the river was needed to live, it was also a deadly enemy. Sacramento has been battling the rivers since even before its birth. In fact, the entire Central Valley of California was known as an inland sea during many winters. Floodwaters would stretch for hundreds of miles from Redding in the north to the San Francisco Bay in the south and from the foothills of the Sierras on the east to the Coastal mountain ranges on the west.

Men and machines have constantly battled these floodwaters. The first public levee protecting Sacramento was built in 1849, the year after the City was incorporated. Since then, a variety of Federal, State and local agencies have tried their hands at protecting the City. SAFCA, or the Sacramento Area Flood Control Agency, working with the Corps of Engineer's and the State Reclamation Board is our generations attempt to control the River.

SAFCA is a joint powers agency which was formed by the City and County of Sacramento, Sutter County, the American River Flood Control District and Reclamation District 1000. The agency has a 13 member Board of Directors representing the five parent agencies. SAFCA has all the same powers held in common by the five entities. It also has the authority to assess benefitting properties to finance flood control projects, including the local share of federal flood control projects. The agency was formed in 1989 following the major flood of 1986 on the Sacramento and American Rivers. By organizing a single regional flood control agency, the Sacramento area felt it had the best opportunity to secure a Federal flood control project. It also provided a single unified local sponsor to work with the State and Federal government. Unfortunately, as time passed so did the memories

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of floodwaters lapping at the tops of levees. Flood control lost its right to step forward in the aftermath of the flood and the will to achieve consensus was lost as age old idealogies on the right project once again raised their heads.

Social Issues

Sacramento is now caught in a changing paradigm, along with the rest of the nation, following major floods in the Midwest, the South, Northwest, South Dakota and now Northern California. The Galloway Report, which was in response to the 1993 Midwest floods, recommends allowing rivers to reclaim their natural floodplains rather than push and shove them unwillingly into the straightjacket levee system. But this policy raises the difficult question of how do we deal with existing urban areas such as Sacramento with over 400,000 people within reach of the rivers floodwaters.

Secondly, who should pay for this flood protection. Should the State taxpayer in Los Angeles or the Federal taxpayer in Wisconsin be expected help subsidize a major flood control project in Sacramento. One could argue that Sacramento tax dollars were spent repairing earthquake damaged freeways in Los Angeles and providing assistance during deadly blizzards in Wisconsin. Also, based on the damages avoided and the assumption that the Federal and State governments will pay, at least in part, for disaster relief; the answer is yes, since money invested in flood control infrastructure in Sacramento will return benefits in disaster relief assistance avoided in the future. In essence, it represents a good investment of the Federal dollar.

Finally, how much flood protection is enough? We cannot guarantee every citizen in this country to be safe from every natural disaster. How much risk are we willing to live with? Sacramento has over $43 billion in damageable property in the floodplain today. The Corps estimate is that damages could be in excess of $7 billion in a 100-year flood. SAFCA has adopted a policy of seeking at least 200-year flood protection in this urban area. This is consistent with the recommendations from the Galloway Report urging Standard Project Flood protection in urban areas.

The Local Sponsor's Role (or Where the Rubber Meets the Road)

Before getting into the details of the American River Project I think a little perspective of how the local sponsor fits into the scheme of Reconnaissance and Feasibility studies, Principles and Guidelines, NED, Division Engineer's Notices, Chief's Reports and the like. As the title above suggests, the local sponsor is where the first political decisions must be made. The Corps has its guidance and regulations to resolve technical issues. However, it is the local sponsor who must sort through this world of engineering graphs and charts and make it seem real for the public and the local officials who eventually must choose a project they are willing to support and assess their constituents to fund. The Corps' job, then, is to provide the clearest road map which has enough information to find a route, but not overly detailed so as to create confusion. This has been the most significant disconnect on the American River Project. The issues have either appeared to be too abstract i.e. a (500-year flood) or their relative importance has not made them a priority in the average citizen's life.

Therefore, it becomes the responsibility of the local sponsor to give the Corps clear direction at critical junctures in the study such as during alternatives evaluation, plan formulation and at conclusion of the Draft Feasibility as to which projects are viable economically, socially and politically. And it is equally important for the Corps to listen to these messages and find a way within their regulations to make a project happen. It should be the common goal of the Corps and the local sponsor to get a flood reduction project in the ground. Each side may have to give a little along the way. The Corps may need to bend the rules from time to time to get an alternative which works for the sponsor, and the sponsor needs to understand the Corps has rules to insure projects from around the country are treated equally. For example, the Corps method of evaluating economic benefits of a flood control project may lead to an NED project which provides unequal levels of flood protection on opposite sides of a stream or in different areas of the community. This may be due to differences in the number of structures protected or the relative economic circumstances of each neighborhood. However, the sponsor will most likely demand that a flood control project should treats all of its citizens equally, irrespective of their economic basis. A compromise might be to agree on a project which costs the same as the NED project but which provides a consistent level of flood protection somewhere between the two unequal levels of protection in the NED plan.

The local sponsor is the first point of contact for the public since they are close to home and generally more familiar than State or Federal representatives. It becomes the arena where the battles are first waged and attempts to reach consensus must be made. Such was the case on the American River project. These attempts proved unsuccessful and eventually spelled defeat at the Federal level, at least in the first two attempts. The Federal officials were always looking to the locals to choose a project which had broad support and bring it to Washington with an agreement at hand. At the local level, elected officials looked to their counterparts in Washington to “make the deal”.

Finally, the local sponsor, in making its choice, must balance the often diverse needs of the community. Yes we need more flood control, but we also need new roofs on school buildings, and more police to patrol our streets. The local sponsors often have to weigh the need for economic growth, jobs and accommodating an influx of new residents into a region with good floodplain management. Is it better to locate far from the river and the dangers of flooding, but put more cars on our highways and more pollution into the air? The answers always seem simple in the aftermath of a flood. Let the rivers be joined with their natural floodplains is the outcry. New development should not be allowed in flood prone areas. But what are the answers in urban areas like Sacramento where the central business district and extensive urbanization already exists in the floodplain?

II. AMERICAN RIVER PROJECT

Historical Flood Protection

In 1955, with the near completion of Folsom Dam and the downstream levees, Sacramento was thought to have 250 to 300 year flood protection. However, in December 1955, just months before the newly constructed reservoir was to begin operations, a major storm hit Northern California. Heavy rains caused uncontrolled flooding in the Feather River Basin north of Sacramento causing extensive property damage and loss of life. On the American River, the flood filled the new reservoir in only four days, a feat the designers expected would take several months to accomplish. Two similarly large storms followed in 1963 and 1964, causing the Corps of Engineers to reevaluate the flood protection afforded by Folsom. By including this new hydrologic information in the calculations, the Corps estimated the flood space in Folsom and the downstream levees could only contain about a 120 year storm. Efforts to improve the situation were tied to the planned multi-purpose Auburn Dam which was authorized in 1965 with construction commencing soon thereafter. An earthquake in nearby Oroville in 1972 stopped construction and raised questions as to seismic safety at the Auburn site. Despite a panel of experts finding in 1979 that a safe dam could be constructed at the Auburn site, new federal cost sharing policies for water and power projects adopted in 1980, prevented the Auburn project from getting started again.

1986 Flood

Sacramento was destined to wait for the next flood to awaken the memories and push for improved flood protection. That flood came in February 1986. After a very dry winter, a series of Pacific storms nicknamed the "pineapple express" because of their origin near the Hawaiian Islands carried wave after wave of warm rain to Central and Northern California. Folsom Dam quickly filled and reservoir operators were forced to release 134,000 cfs, exceeding the design release of 115,000 cfs for over 36 hours. Meanwhile, downstream levees contained the record flood flows with boils and seepage evident at several locations. Extensive erosion along the levee toe occurred to both the north and south levees of the American River near California State University, California.

Along the Sacramento River, the levees fared worse. Like the American River, record stages were recorded at the I Street Gage adjacent to Old Sacramento. Levees in the Natomas area near Sacramento International Airport experienced considerable seepage and erosion along the landside. Only a determined flood fight prevented collapse of the east levee of the Sacramento River (which protected more than 35,000 residents of the Natomas area). Fortunately for Sacramento, the rain slowed just in time. Inflows to Folsom Dam finally dropped. Had the rains continued even for a few more hours, the releases at Folsom were to be increased to 150,000 cfs which would likely have led to catastrophic levee failure in the heart of Sacramento, significant property damage and a potential for loss of life. Based on what we have learned about our system since 1986, there probably should have been an evacuation of the American River floodplain that February day.

Significant flooding did occur in the Strawberry Manor neighborhood, a low income area in North Sacramento adjacent to Arcade Creek. Floodwaters outflanked the levee system upstream as well

as leaking out of the levees at a nearby road crossing below the top of the levee. In addition, large low lying areas were flooded in Roseville and Rio Linda/Eleverta in northern Sacramento County along Dry Creek. Finally, flooding occurred in agricultural lands north and east of Sacramento from a combination of high river stages.

System Re-evaluation

After the 1986 flood, the Army Corps of Engineers initiated a comprehensive evaluation of the entire Sacramento River Flood Control System. The first phase of this evaluation focused on the east levee of the Sacramento River, which protects Natomas, Downtown Sacramento, and the urbanized areas to the south. As previously discussed, these levees were constructed in the early 1900s, using material dredged from the river channel. Due to the sandy quality of this material (much of which was deposited in the river bed during the hydraulic mining era in Northern California) and poor compaction methods, the Corps determined that 33-miles of levee along the Sacramento River between Freeport and the mouth of the cross channel were structurally deficient.

Without remedial work, the Corps concluded, high flows in the Sacramento River could produce enough seepage through the levees to trigger a breach. The east levee protecting Natomas between the mouth of the American River and Verona, where severe seepage and a near breach occurred in 1986, was found to be particularly vulnerable; the east levee south of the American River to Freeport was reported to be in slightly better condition, but still in need of repair.

In addition, the Corps re-evaluated the frequency of flooding in the American River Basin. As previously noted, prior to 1986, Folsom Dam and the lower American River levee system were thought to provide a 120-year level of flood protection to the residents and businesses occupying the American River floodplain. After the 1986 flood, using data gathered from the storm itself and hydrologic information compiled since the construction of Folsom, the Corps downgraded the system's flood control capacity to a 63-year level. This meant that there was a greater than 1.6 percent chance *in any given year* that a flood event would exceed Folsom's capacity. It is also interesting to note, the seven largest floods of this century all occurred after construction of Folsom and therefore none were considered in the design of the reservoir (Attachment A).

The Corps also concluded that the levees along the Natomas East Main Drainage Canal (NEMDC), which protect Natomas and the Dry Creek area to the east, were too low to safely contain the flows produced by the coincidence of peak discharges in Dry and Arcade Creeks and maximum flood releases from Folsom.

As a result of these findings, the Federal Emergency Management Agency (FEMA) reassessed the 100-year floodplain in the Sacramento area and issued new Flood Insurance Rate Maps (FIRMs). These maps, which became effective in November 1989, mandated the purchase of flood insurance by all residents and businesses within the 100-year floodplain and caused the City of Sacramento to impose severe restrictions on new residential development in the Natomas area.

What's at Risk?

The overlapping American and Sacramento River floodplains encompass a land mass of more than 100,000 acres. About half of this land lies within the Natomas Basin, an agricultural reclamation district that has experienced significant development pressure during the past two decades and now contains over $2 billion worth of damageable residential, commercial and industrial property, including Sacramento International Airport.

Outside Natomas and the Dry Creek area immediately east of the basin, the floodplain straddles the American River. To the north, it covers about 6,000 acres, including the state fairgrounds at Cal Expo, the Campus Commons subdivision, and a portion of North Sacramento near McClellan Air Force Base. South of the American River, the floodplain covers about 45,000 acres, encompassing much of downtown Sacramento, the State Capitol, California State University campus, the City's water treatment facilities, the River Park neighborhood (adjacent to the river northeast of the downtown core), and a number of large residential areas to the south.

Although the Corps has estimated that this section of the floodplain outside Natomas and Dry Creek contains over 300,000 residents and $30 billion worth of damageable property, grade elevations for most of this area are significantly lower than water surface elevations in the river channels during major floods. Thus, the potential exists for extensive deep flooding in the event the levees are overtopped, or if they otherwise fail due to prolonged high flows. As a result, the Corps estimates that a levee failure along the American River could cause as much as $9 billion worth of damage in Sacramento, slightly more than the losses attributable to the 1989 Loma Prieta earthquake in the San Francisco Bay Area.

Action Plan

Out of the ashes of the 1986 flood came a strategy to address the significant and unacceptable flood risk in Sacramento which was embraced by federal, state and local officials.

1. Stabilize and strengthen the existing system;
2. Temporarily use Folsom Dam and Reservoir for more flood control storage space;
3. Plan and implement a long term project providing Sacramento a high level of flood protection.

The first two goals of the strategy have either been accomplished or are in progress. When the strategy was first developed, the intent of the first task was simply to rehabilitate the Sacramento River levees. This was accomplished by placement of a landside berm, or through placement of slurry wall down the center of the levee. Unfortunately, as time passed, we have found the need to repair and replace components of the existing system are an on-going, and possibly never ending series of tasks. For instance, in the summer of 1995, a radial gate at Folsom dam broke spilling 40,000 cfs into the downstream system in July. During the 1997 flood, serious damage was found in the low level river outlet tubes at Folsom caused by cavitation; and the stilling basin below the emergency outlet gates was also damaged. The Corps has now determined the American River levees are in need of work to reduce the risk of seepage and catastrophic levee failure during periods of high water. The

Corps is now in the final design stages of a project to place the slurry walls in all the American River levees downstream of Folsom Dam to address the seepage and stability concerns.

The rehabilitation efforts are not limited to the major river systems such as the Sacramento and American Rivers. SAFCA has recently raised and/or constructed new levees along approximately 20 miles of channels protecting the Natomas basin and North Sacramento. SAFCA is also partnering with the Corps on projects in South Sacramento and Magpie Creek; both existing flood control projects which are now deemed inadequate primarily due to changes in hydrologic assumptions.

The second goal was accomplished via an agreement between SAFCA and the Bureau of Reclamation. Under this agreement, sufficient space is to be maintained at Folsom together with existing space in the three largest upstream hydro-power reservoirs to contain the 100-year flood. If the operation resulted in any water, power, or environmental impacts, SAFCA will compensate the impacted user.

The last goal in the strategy has proven to be the most elusive because of its nexus to Auburn Dam. The choices for long term flood protection essentially come down to three options; dedicate more space at Folsom for flood storage; make major modifications to the existing system (i.e. raise levees, re-configure the outlet works at Folsom) in addition to increased flood storage capacity; or add new storage to the system by building another dam.

As I said, immediately following the flood, the need for improved flood control took center stage and it seemed a compromise project would quickly move forward in the process. That compromise project was a "dry dam". The dry dam would only hold water in the winter during a major flood, and only for a brief time (estimated at 21 days for a 400-year flood). However, this dam would be constructed in a manner that it could be expanded into a multi-purpose dam as envisioned by long time supporters of the original Auburn Project. However, as time passed and memories of the 1986 flood faded, so did the will for the diverse interest groups to compromise and reach consensus. People returned to their polarized positions on Auburn.

There were those who only wanted a multi-purpose Auburn dam and felt money spent on a "dry dam" was wasteful. They also felt strongly that once Sacramento solved its flood control problem, the momentum for the big dam would be lost along with the commitment of federal dollars. By contrast, the environmental interests who wanted no dam at the site saw the dry dam as the proverbial "camel's nose under the tent". Once a dam was built in the canyon, they surmised, under interests would figure a way to permanently store water behind it. With this "horseshoe alliance" joining forces (and subsequently being joined by taxpayers groups) in 1992 to oppose the project in Congress, the project was doomed to failure.

Similar efforts were remounted in 1996 following the change in political leadership in Congress following the 1994 elections. This time, the supporters of the multipurpose dam were in support of the dry dam as the first step towards the big dam. Despite this support, the environmental and fiscal conservative interests were again strong enough to stop the project. The only elements of the plan which were eventually authorized by Congress were those features which were needed irrespective

of whether the project was a dam at Auburn or improvements to the existing system. These features were termed the "Common Elements".

Future Efforts

Following the defeat in 1996, SAFCA, the State and Corps are in the process of reanalyzing our position. One thing is clear, no project will move forward which does not have a broad range of support. This includes consensus at the local level, support from both political parties in Congress, as well as support (or at least not opposition) from the impacted special interest groups such as the water users and environmentalists. It is much easier to stop a project from moving through the process than it is to actually make a project happen. Therefore, our next goals are to identify those specific elements which can garner this base of support.

The most likely candidate is some modification to Folsom's outlet works. All agree the current configuration with the spillway crest very high on the reservoir is very ineffective. The low level outlet capacity of the reservoir is limited to a maximum release of 35,000 cfs which is much below the downstream design release capacity of 115,000 cfs. In fact, the reservoir must reach a storage capacity of almost 800,000 acre-feet (halfway encroached in the flood storage space) until the releases can match the downstream capacity. By enlarging the size of the low level outlet gates and adding four additional outlets, the release capacity could be increased to approximately 70,000 cfs at reservoir levels below the spillway crest.

This improvement would benefit downstream interests by allowing increased releases earlier in a storm reserving more space to contain larger floods. For upstream interests who are adversely impacted by low reservoir levels when floodwaters are released and not replenished, this modification could also be of benefit. With the ability to release larger amounts of water early in a storm, operators could allow a fuller reservoir during the flood season and make anticipatory releases based on weather forecasts or maybe even after actual rainfall has been measured. This would allow the reservoir to remain at higher levels in the later winter and early spring thus increasing the chances for full recharge or at least insure the reservoir would be at higher levels in the summer than it is with the existing configuration and flood capacity.

III. RISK BASED ANALYSIS

Measuring Risk

Since the topic of this workshop is risk and uncertainty. It is appropriate to talk about both. When we think of risk what comes to mind is the fact we are taking a chance on something in which the outcome could be adverse. The parallel is luck in which we are taking a chance and something good could happen to us. Flood control is certainly a risk. Each year we are taking a chance with the consequences of losing being catastrophic flooding, huge property damages and potential for loss of life. In Sacramento, even with the current agreement on flood storage space at Folsom, there is greater than a 1% chance of a major flood in Sacramento **each** year. Over a 30-year period, this equates to a greater than 1 in 4 chance we will experience catastrophic flooding.

Yet, in the minds of the general public, this risk is not real. Yes there are areas which have flooded, but generally they are the same areas which always seem to flood. The bulk of the populace sits behind the levees oblivious to the potential risk. Over the past six years working in Sacramento, I have been approached by literally dozens of people who confidently proclaim they have never flooded since living in their houses and therefore do not believe they are at risk of flooding in the future. Though I quietly remind them we have not had a 100-year flood in modern times on the American River, they also remind me, each time we have a flood, the definition of the 100-year flood seems to change. Finally with the recent floods of last January 1997, in which levees were failing up and down the system on a daily basis, it seems the public as more aware of the risk living behind levees. The current media coverage of the El Nino condition in the Pacific has further heightened the public's concern about flood risk. Flood insurance is becoming the newest hot commodity on the market.

The City of Sacramento in its Comprehensive Flood Management Plan published in 1996, tried to compare the flood risk in the City with other common risks. Attachment B shows the comparison. As one can see, the risk of flooding is far greater than other common risks such as a house fire, developing cancer or being involved in a fatal car accident. Despite this fact, almost all structures carry fire insurance, but only about one-third of the houses in the floodplain carry flood insurance. The risk is not real in the eyes of the public. The average citizen in this community believes they are at far greater risk of being a murder victim than of being a flood victim. Our challenge is to make the flood risk as real as the crime risk. The facts and message need to be delivered in terms which can be generally understood by the public at large.

In the preceding paragraphs where I discussed the alternatives to improving flood protection in Sacramento, there was mention of political parties and special interest groups. The group with the largest at stake, the floodplain residents, were not a force. They were a disinterested third party in the debate. It was the one group, which if mobilized, could have swayed the decision. Our challenge is to get this group of stakeholders to be active participants in the process.

Risk and Uncertainty

There are two areas where the Corps new method of planning and implementing flood control projects through the use of the risk based analysis has impacted the American River project planning process. The first is in trying to describe true risk and the levels of flood protection provided by the various alternatives studied. Sacramento and its elected officials have come a long way since 1986 in understanding how our complex flood control system works and what flood risk is about. We have been able to break through the 100-year flood myth propagated by the National Flood Insurance Program. Under this myth, once there is greater than 100-year flood protection there is no longer a flood risk.

We have slowly been able to educate a portion of the community that flood risk does not disappear with 100-year protection. We have quantified 200- and even 500-year flood events. Protection provided by projects are now described in terms of the flood risk over a 30-year period (the typical life a mortgage on a house). For instance, even with 100-year flood protection the risk of flooding is still 26% over a thirty year period, over a 50 year period the risk is 40%--almost a coin toss. With

200-year protection, the risk is reduced to 14% over thirty years and with 400-year protection, the risk is reduced to just 7%. However, even with this correlation between level of protection and residual risk, the jargon which is still the most clearly understood is measuring projects by the levels of protection they provide (i.e. the true exceedance).

With the introduction of the R & U package, the concept of reliability was intermixed (Attachment C). Under this new way of describing flood control projects, a single number is not used for the level of protecion but rather each project has a certain "reliability factor" assigned that it can pass a given flood event. This concept, though more technically correct since it considers there are a number of uncertainties inherent in hydrologic and hydraulic calculations, does not provide a high comfort level for people used to dealing in absolute numbers. This concept becomes even more difficult when you take a particular project to the public and ask them to pay for it. How do we sell a project which may have a true exceedance of 200-year, but may have a reliabliity factor of less than 80% for passing this flood? Even worse, the same project may have a reliability factor such that it could not be certified as providing 100-year flood protection under FEMA's guidelines. Such was the case on the American River project, where the stepped release plan which had a true exceedance of 235-year protection but which may not pass the 100-year event with sufficient reliability to be certified under preliminary criteria being set forth by the Corps and FEMA.

To avoid much of this confusion on the American River project, we limited our discussions with the public and the elected officials to using the true exceedance values. Each of the alternative projects was described as providing a certain level of flood protection, (Attachment D) but to make the correlation to risk, the alternatives were compared in terms of flood risk over a 30-year period. The Folsom Modification Plan provided 180-year protection (17% risk), the Stepped Release Plan provided 235-year protection (15% risk); and the Detention Dam Plan provided 500-year protection (5% risk). Using these numbers, the elected officials, and members of the public who followed the process were able to quickly grasp the relative differences in terms of proteciton and costs while not losing sight of the residual risk which remains even with the projects in place.

The second issue which has surfaced with the use of the R & U package is what are the potential hydraulic impacts of these flood control projects where there really is no design flood level or design flood event? Under the previous design standard, a water surface elevation was set based on a design storm, and a freeboard factor (typically 3 feet) was added to establish a top of levee. In anlyzing the levee, it was presumed the levee would fail at some point when the water encroached into the freeboard. Under FEMA's criteria, failure was assumed for any encroachment into the freeboard. Hydraulic impacts of the project on upstream or downstream properties were limited to analyzing the design event since larger events were presumed to fail the levee thus relieving the impacted properties.

Under the R & U method, there no longer is freeboard but a probable failure point (PFP) and a probable non-failure point (PNP). Floods below the PNP are assumed to be contained by the levee, floods with stages greater than the PFP are assumed to fail the levee while floods with water surface elevations between the PNP and PFP may or may not fail the levee and are assigned a weighted probability of failure in relation to the PFP and PNP. This now plays into the hydraulic impact arena,

because it is recognized that levees may contain floods up to the PFP and therfore any hydraulic impacts of a flood up to the PFP level may be realized.

This very circumstance is the subject of intense debate between SAFCA and a number of property owners in the lower Dry Creek watershed (Attachment E). By constructing levee improvements protecting the Natomas basin, North Sacramento and portions of Elverta/Rio linda, the floodwaters which would otherwise flood these areas are now contained between levees in the lower Dry Creek floodway raising the water surface elvations for a given flood event in the post- vs. pre-project condition. In 1993, we analyzed the impacts of the project for the design flood event and found only a few structures in the lower part of the watershed would be impacted. SAFCA agreed to compensate these property owners for the loss of use of their property. In the end, we will end up purchasing these structures to eliminate future liability and to further the County and City's goal of creating a Dry Creek parkway.

However, when we were about to proceed with the last element of the project, completion of the south Robla Creek levee improvements in 1995, a group of property owner's above the impact zone identified in the 1993 hydraulic impact analysis challenged our conclusions. In their minds, we should analyze the impacts of larger flood events up to and including a flood to the top of the levees. Based on a cursory analysis, this would be on the order of a 1000-year event since our design criteria was to design a top of levee 3 feet above the 200-year water surface elevation.

As a way to move forward in 1995, we agreed to build a staged project and only complete the improvements after an analysis of the impacts due to larger than the design flood event. This decision was partially attributable to the new R & U standards applying to levee analysis. In our estimation, if the levees can be credited with providing flood protection with the freeboard area, then we should also consider the potential impacts of containing such a flood. Despite the demand to look at a top of levee flood, we limited the analysis to floods up to and including the 500-year flood which is the estimated PFP of the proposed levee. As expected, the analysis showed greater impacts of the project extending futher upstream. The new impact area at the 500-year includes approximately 80 homes, an apartment complex, and a small private airport.

The impacts, though real, have been determined to be small; generally 0.2 feet at the 100-year flood and 0.4 feet at the 500-year flood. Most structures impacted at the 500-year event are already flooded by this event even without our project. We are increasing the depth of flooding on these already flooded structures.

We had an expected annual damage analysis done for these structures to determine if the potential damages imposed by our project warranted any mitigation. The total increase in EAD for all the impacted structures was only about $4,000. The cost to mitigate for the impact by protecting the structures with flood control measures would cost in excess of $1 million. SAFCA agreed to contribute a share of the mitigation costs if the property owners would cost share. Nevertheless, the Reclamation Board of the State of California stepped into the negotiations and has included a condition on our permit to construct the downstream levees which states we must mitigate any increase in EAD or decrease in level of protection attributable to our project.

Similar discussions are beginning on other Corps projects in the Sacramento area, most notably Magpie Creek Diversion and South Sacramento Streams Group where downstream properties will be impacted by more water being brought into the area. In at least one of these projects, the Corps has opted to use levee failure at the PNP rather than the PFP as the basis for determining hydraulic impacts.